JPRS L/9046

21 April 1980

USSR Report

ENGINEERING AND EQUIPMENT

(FOUO 4/80)

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200070039-0

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USSR REPORT

ENGINEERING AND EQUIPMENT

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TURBINE AND ENGINE DESIGN

STATICS AND DYNAMICS OF ROCKET PROPULSION DEVICES

Moscow STATIKA I DINAMIKA RAKETNYKH DVIGATEL'NYKH USTANOVOK, V DUKH KNIGHAKH in Russian 1978 signed to press 15 Nov 78 pp 318-319

[Table of contents of monograph by Yevgeniy Borisovich Volkov, Timofey Aleksandrovich Syritsyn and Goergiy Yur'yevich Mazing, "Mashinostroyeniye" Publishers, 319 pages, 1500 copies]

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CSO:8144/0654

Fluid Mechanics

USSR UDC 533.69.011

SIMULATION OF THE AIRSPEED FIELD IN THE AIRFOIL PROFILE ZONE AND THE DESIGN OF DEICING SYSTEMS

Kiev AERODINAMIKA in Russian No 3, 1977 pp 13-19

SUKHARNIKOV, YU. V. and KOVAL', YU. G.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1244 by the authors]

[Text] The findings on the simulation of the airspeed field on an EGDA-9/60 integrator are compared with their counterparts obtained with the aid of a BESM-6 computer for the same points. Statistical analysis of the results shows that the speeds obtained on the integrator generally exceed by 17.5% the speeds obtained numerically. With approach to the contour of the airfoil the error increases. The use of numerical methods for the determination of air speeds in the flow field around the airfoil yields a more reliable flow pattern and markedly reduces the technological time of calculations and of the optimization of aircraft deicing systems. References 6.
[25-1386]

USSR UDC 533.697

EVALUATING THE POTENTIAL OF AIRBORNE CENTRIFUGAL SPRAYERS

Kiev AERODINAMIKA in Russian No 3, 1977 pp 108-114

LOGACHEV, YU. G. and SILYUTIN, V. F.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1373]

[Text] Formulas for the motion of a layer of granular substance in the impeller and the laws governing its performance are presented. Formulas determining the rate of ejection of granular substance, the required power, the impeller capacity, and the lag angles of ejection relative to the load and the deflection of the particle ejection rate vector from the direction tangential to the impeller also are given. These data are necessary to assess the possibilities of aircraft centrifugal sprayers.
[25-1386]

USSR UDC 533.69.011

FINITE-SPAN WING IN TRANSONIC GAS FLOW AT M > 1

Irkutsk ASIMPTOTICHESKIYE METODY V TEORIYI SISTEM [Asymptotic Methods and Systems Theory] in Russian 1977 pp 33-46

SIGALOV, G. F.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1237 by A. F. Kryuchin]

[Text] Aerodynamic characteristics of an airfoil of rectangular planform at an angle of attack within the supersonic range of the transonic flow of an inviscid gas are investigated. The case of an airfoil with a supersonic trailing edge for the aspect ratio $\lambda \geq 2/k$, where

RP180A $$k = \sqrt{M_\infty^2 - 1}\left[1 + \frac{c(\gamma+1)M_\infty^2}{3(M_\infty^2-1)}\right]$$

is investigated.

The input equation and boundary conditions for the potential of perturbed velocities in the investigation of the boundary-value problem were as follows:

RP180B $$\left[M_\infty^2 - 1 + M_\infty^2(\gamma+1)\varphi_x\right]\varphi_{xx} - \varphi_{yy} - \varphi_{zz} + O(\varepsilon^{2+k}) = 0$$
$$\varphi_{z\pm} = [(1+\varphi_x)F_x]_\pm + O(\varepsilon^{2+n})$$

where $F_\pm$ is the equation of the upper "+" and lower "-" airfoil surfaces; $\varepsilon \ll 1$ is a small parameter of the perturbation; $0 < n \leq 1$. This nonlinear differential equation reduces to a wave equation on transition to the space of deformed variables related to the coordinates of physical space by the following formulas:

RP180C $$x = \xi + \varepsilon X(\xi, \eta, \zeta) + O(\varepsilon^2); \quad y = \eta/k; \quad z = \zeta/k$$

The distribution of the pressure coefficient on the airfoil surface was determined separately for areas with and without the end effect. By way of an example, a calculation of the distributed and lumped aerodynamic characteristics for an airfoil of rectangular planform with a rhomboidal profile in the presence of zero sideslip angle is presented. Analysis of the computational findings shows that nonlinear effects reduce the effect of the airfoil tips on lift compared with a slender airfoil. The lift coefficient and the drag coefficient prove to be higher than those ensuing from the linear theory. These effects are particularly notable at $M_\infty = 1.1$-1.3 and they rapidly converge with the findings of the linear theory when the Mach number is increased to $M_\infty > 1.3$. References 11.
[25-1386]

USSR UDC 533.69.011

SLENDER CURVED-SPAN AIRFOILS WITH A LOW ASPECT RATIO IN THE NEIGHBORHOOD OF A SCREEN

Irkutski ASIMPTOTICHESKIYE METODY V TEORII SISTEM [Asymptotic Methods in Systems Theory] in Russian 1977 pp 64-70

YEZHOV, V. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1247 by A. V. Kolesnikov]

[Text] Flow around slender curved-span airfoils with a low aspect ratio in the neighborhood of a screen is investigated from the standpoint of the quadrupole theory. Formulas expressing the first and second derivatives of the logarithmic potential of an elementary layer with doubly differentiated density through the potentials of the elementary and double layers with some new density are derived. These formulas are used to transform the basic equation of the problem of flow around any airfoil in the neighborhood of a screen.

Examples of application of the method for computing flow around a plate with a low aspect ratio as well as around a slender airfoil in the neighborhood of a screen are presented. References 5.
[25-1386]

USSR UDC 533.69.011

INVESTIGATION OF THE MOTION OF AN AIRFOIL IN THE NEIGHBORHOOD OF AN AGITATED SURFACE

Irkutsk ASIMPTOTICHESKIYE METODY V TEORII SISTEM [Asymptotic Methods in Systems Theory] in Russian 1977 pp 163-177

POPOV, K. B.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1245 by A. V. Kolesnikov]

[Text] The first part of this study deals with determining the singular component of the solution of the plane problem of the motion of an airfoil in the neighborhood of an agitated surface in the case of small perturbation amplitudes. Formulas for the instantaneous lift coefficient are derived. The dependence of the influence function on the Strouhal number and the distance to the airfoil is investigated.

Part Two deals with the motion of a zero-aspect wing in the neighborhood of an agitated surface. A formula for the lift coefficient is derived, and the findings are compared with the data of the quadrupole theory of airfoils. References 14.
[25-1386]

USSR UDC 132.126

THREE-DIMENSIONAL BOUNDARY LAYER WITH EQUILIBRIUM REACTIONS OF DISSOCIATION AND IONIZATION

CHISLENNYYE METODY MEKHANIKI SPLOSHNOY SREDY in Russian No 7, 1977 pp 53-65

KAZEYKIN, S. N., TIRSKIY, G. A. and SHEVELEV, YU. D.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract 8B168 by V. G. Voronkin]

[Text] A three-dimensional laminar boundary layer in an equilibrium multicomponent gas is considered with allowance for reactions of dissociation and ionization on condition of quasineutrality of the mixture. An exact system of equations of this layer in the multicomponent mixture is formulated. Subsequently a simplified thermochemical model of the mixture is used. In this mixture the gas is considered to consist of four components: molecules, atoms, ions, and electrons. Such a model is suitable for, e.g. an approximate description of the thermochemical state of the air at temperatures of up to 15,000 K. A method for the integration of boundary-layer equations based on the successive approximation method is proposed. Finite formulas for the heat flux and the coefficient of surface friction are derived to a first locally self-similar approximation. Sample calculations pertaining to a cylinder with semispherical blunting at the angle of attack are presented. References 7.
[25-1386]

USSR UDC 533.6.013.42

MOTION OF AN ELASTIC SPHERICAL SHELL IN A VISCOUS FLUID

Dnepropetrovsk DVIZHENIYE UPRUGOY SFERICHESKOY OBOLOCHKI V VYAZKOY ZHIDKOSTI in Russian Manuscript deposited at VINITI 25 Apr 78 No 1427-78 Dep. 1978, 9 pp

KUZNETSOV, V. N.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V506DEP by the author]

[Text] The deformation of an elastic spherical shell in a viscous fluid agitated from a state of rest into translational, rectilinear, and uniform motion, is considered. The problem is solved on the basis of linear Navier-Stokes equations and equations of axisymmetric oscillations of an elastic shell. The solution of these equations is achieved with the aid of the Laplace integral transform method with respect to time, with expansion of functions in series with respect to Legendre polynomials. The numerical findings presented point to a variation with time in the velocity of the shell in the presence of viscosity of the ambient medium. References 6. [25-1386]

USSR UDC 533.697

DETERMINATION OF THE CONSTRICTION OF THE GAS JET IN A BORDA MOUTHPIECE

Tomsk GAZOVAYA DINAMIKA [Gas Dynamics] in Russian 1977 pp 3-9

TOMILOV, YE. D.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1364]

[Text] The constriction factor of a jet entering a Borda mouthpiece from a gas flowing through a channel with parallel walls is determined. The mouthpiece is positioned along the axis of symmetry of the flow. The solution of the problem is obtained with the aid of the momentum theorem for two cases in which the mouthpiece is positioned downstream and upstream, respectively, with respect to the flow. It is established that the resulting constriction factors in the case of an incompressible fluid coincide in value with their counterparts obtained by other investigators. The solution of the problem of a jet entering a Borda mouthpiece from a boundless flow for the above mentioned two cases is also obtained, for the critical transition. It is shown that in the case of a gas at rest at infinity the

known formula for the constriction factor is obtained. This also applies to the case of incompressible fluids, whether moving or at rest at infinity. [25-1386]

USSR UDC 532.7?:669.015.23

ADVANCES IN THE SCIENCE OF HEAT AND MASS TRANSFER

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 33, No 5, 1977 pp 773-801

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B545 by V. Ye. Fertman]

[Text] Research findings made by the nation's leading organizations in the field of heat and mass transfer during the last ten years are presented. The section on "General Problems of the Theory of Heat and Mass Transfer" names the research groups working on the development of the phenomenological theory of heat and mass transfer, as well as the organizations developing methods of the kinetic theory. The section on "Convective Heat and Mass Transfer" presents the findings of research into heat transfer with induced convection, in a field of body forces, and on the interaction between high-temperature gas streams and various materials. The sections on "Heat and Mass Transfer in Phase Transitions," "Heat and Mass Transfer in Fluidized-Bed Systems," "Heat and Mass Transfer in Drying Processes," "Heat and Mass Transfer in Rheologically Complex Systems," "Investigation of Thermophysical Properties of Substances," and "Processes of Heat and Mass Transfer in Laser-Active Media and High-Temperature Plasma" deal with present-day trends of research into heat and mass transfer processes and certain findings of basic and applied research.
[25-1386]

USSR UDC 533.9

CERTAIN FINDINGS OF AN INVESTIGATION OF THE HEAT TRANSFER BETWEEN ONE- AND TWO-COMPONENT PLASMA STREAMS AND REACTOR WALLS

Minsk ISSLEDOVANIYA PLAZMENNYKH PROTSESSOV I USTROYSTV [Research Into Plasma Processes and Devices] in Russian 1978 pp 49-61

BUROV, I. S.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B371]

[Text] The findings of an experimental investigation of heat transfer between an air plasma stream and the channel walls in a reactor with a multijet mixing chamber are presented. Formulas of the type $St_l = ARe_{xl}^{-m}Pr_l^{-0.67}$ are used to generalize the findings for channels with diameters of 0.100 and 0.50 m, including the mixing chambers. It is established that the addition of a dispersed material with a mass flow concentration of 0.2-2.0 to the plasma stream results in reducing the heat flux to the channel walls. The variation in the heat flux to the channels of the multijet mixing chamber is taken into account by dependences of the type $Q_{wp} = Q_w \varepsilon_{wp}$, where $\varepsilon_{wp} = A/\mu_p^h$. References 19.
[25-1386]

USSR UDC 541.24:532.5

HEAT TRANSFER AND THE FLOW OF HELIUM IN CHANNELS. PRACTICAL APPLICABILITY LIMITS OF SUPERCONDUCTIVITY

Moscow KRIOGENNOYE OBORUDOVANIYE. SVERKHPROVODIMOST' I IZMERITEL'NAYA TEKHNIKA [Cryogenic Equipment. Superconductivity and Measurement Technology] in Russian Vol 5, 1977 pp 5-22

DZHONS, M. and DZHONSON, V.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B747 by T. M. Muratova]

[Text] A broad range of problems associated with heat transfer to helium during its induced flow in the channels of superconducting devices is considered. The survey reflects the present state of the art. The first section, preceding an analysis of heat transfer, focuses attention on features of the near-critical region of states which becomes the natural operating range for helium upon the cooling of superconductors. It is

pointed out that in research into modes with supercritical pressures allowance should be made for the imprecision of the existing data on the viscosity and heat conduction of helium within the 4-20 K range.

In the analysis of heat transfer in supercritical helium it is pointed out that, although high values of the heat transfer coefficient are reached at high flow velocities, there may occur a deterioration in heat release (local temperature bursts) owing to insufficiently investigated causes, and this may result in undesirable consequences. Known empirical formulas used to calculate the heat transfer coefficient in the presence of small and large heat fluxes, far from and close to the pseudocritical temperature, are presented. The findings of experiments by Giaratano and Jones with descending heat flux in a tube of 2.13 mm diameter under a pressure of 0.25 MPa, specially organized to detect the deteriorated modes of heat transfer, are described: in these experiments the density ratio of helium in the neighborhood of the wall to helium in the flow core reached 10. The findings are presented in the form of the dependences of the local heat transfer coefficients on the flow rate and temperature of helium and on the heat flux. The pattern of deviation of the heat transfer coefficients from the limiting values corresponding to pseudothermal flow with increase in their temperature inhomogeneity is traced.

On the basis of the Prandtl theory of turbulent transport, approximate correlations are constructed to describe the deviation from the standard dimensionless velocity profiles and enthalpies corresponding to the limiting case of constancy of the fluid's properties over the cross sectional area. The resultant correction to the classical heat transfer coefficient is the product of the density ratios, specific heats, and Prandtl numbers taken at the temperature of the flow and of the wall.

Heat transfer in the presence of mixed convection in vertical and horizontal channels is considered. Recommendations are made for determining the limiting Reynolds numbers as functions of the Grashof number at which a sharp decrease in tangential stress in the ascending flow in the neighborhood of the wall (and as a consequence, a decrease in heat transfer rate) can be expected. An analogous criterion is given for horizontal channels, as proposed by B. S. Petukhov; this criterion determines the possibility of onset of a mixed-convection mode.

Aspects of heat transfer during the boiling of subcritical helium are considered. It is pointed out that nucleate boiling in channels occurs analogously to the basin boiling mode. Special attention is devoted to the transition to the film boiling mode owing to a marked increase in wall temperature, which is often impermissible in the operation of superconducting systems. An empirical formula for determining the critical heat flux, which satisfactorily describes the known experimental data, is proposed.

A large section of this review is devoted to the heat conduction of helium-II. Specific effects characteristic of superfluid liquid helium are

described in accordance with the transport mechanism reflecting the properties of the two-fluid model. Problematic aspects of critical fluxes (transition to dry-wall mode), transfer of fluid by means of pumps, etc. are discussed. The existence of major gaps in the present-day system of the theories of the properties of helium-II and of the possibilities for its application in superconductor technology is stressed. On the basis of literature data on oscillatory processes in systems with induced motion of cryogenic and other fluids, three different types of oscillations are identified. Theoretical amplitude-frequency characteristics of the process of the propagation of perturbations in forced flow of supercritical helium are presented. It is pointed out that the findings of research into the oscillations serve in certain cases to determine the instability criteria for superconducting systems, i.e. the conditions for the existence of undamaged oscillations of a corresponding mode. It is stated, however, that in most cases there are no theories to formulate the laws governing the propagation of perturbations in helium channels. References 41.
[25-1386]

USSR UDC 533:538

OPTIMAL PERFORMANCE CHARACTERISTICS OF A CONDUCTION CHANNEL

MAGNITNAYA GIDRODINAMIKA in Russian No 1, 1978 pp 125-131

OKULOV, N. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B305 by L. G. Genin]

[Text] For the laminar steady flow of a viscous incompressible electrically conducting fluid in a cylindrical channel in a transverse magnetic field, the variational method is used to determine the potential distribution over the contour at which the local electrical efficiency is maximized. The performance of the channel in the generator and pump modes is examined, assuming constancy of the magnetic field applied and of the longitudinal pressure gradient. Formulas for local electrical efficiency are derived and analyzed.
[25-1386]

USSR UDC 539.3

STEADY-STATE PROBLEM OF HEAT CONDUCTION FOR A CLOSED SPHERICAL SHELL WITH A LONGITUDINAL HEAT-INSULATED CRACK

Kiev MATEMATICHESKIYE METODY V TERMOMEKHANIKE [Mathematical Methods in Thermomechanics] in Russian 1978 pp 90-96

OSADCHUK, V. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V190]

[Text] A solution of the steady-state heat conduction problem is presented with respect to a closed endless cylindrical shell with a longitudinal crack with consideration of the effect of the shell's curvature on the temperature distribution, assuming that the shell exists under conditions of variable temperature and heat transfer with the ambient medium in accordance with Newton's law. When the apparatus of generalized functions is employed, the problem reduces to the solution of a system of two singular integral equations from which the functions characterizing the discontinuities of integral temperature characteristics are derived. References 9. [25-1386]

USSR UDC 533.6.013.42

DYNAMICS OF THE BLADES OF GAS TURBINE ENGINES IN UNSTEADY FLOW

MEKHANIKA POLIMEROV in Russian No 2, 1978 pp 257-264

VOL'MIR, A. S., GULYAYEV, V. V., MIKHNEV, V. F. and PONOMAREV, A. T.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V502 by the author]

[Text] The aeroelastic characteristics of compressor-cascade blades made from a composite material are investigated in unsteady flow. The solution of this problem is based on the numerical methods of unsteady-state aerodynamics and on refined formulas of the theory of anisotropic shallow shells of the Timoshenko type. The disk is considered to be absolutely rigid, and allowance is made for aerodynamic interaction between neighboring blades. The resolving system of linear integro-differential equations of unsteady-state aeroelasticity is set up on the basis of the integral representation method. The motion of the elastic system is resolved with respect to modes of free oscillations of the structure in a field of centrifugal forces, derived with the aid of the finite element method. The aerodynamic load is

found in terms of generalized transfer functions of pressure by solution of the basic gas-dynamic problems by the discrete-vortex method. The combining of both parts of the problem is accomplished with the aid of a convolution integral. Sample subsonic flow in a fiberglass-plastic blade cascade is considered. The numerical findings are presented in the form of plots illustrating individual aspects of motion of the system as well as the resultant motion. References 12.
[25-1386]

USSR UDC 532.593

EFFECT OF SURFACE TENSION ON THE GENERATION OF WAVES BY PERIODIC PERTURBATIONS IN AN INHOMOGENEOUS FLUID

MORSKIYE GIDROFIZICHESKIYE ISSLEDOVANIYA [Marine Hydrophysics Research] in Russian No 3, 1977 pp 32-43

BUKATOV, A. YE.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B41]

[Text] The effect of surface tension on the development of waves generated by periodic perturbations in a two-layer fluid is investigated. The perturbations are represented by pressures applied to the free surface, a source existing in the fluid at a specified depth, and oscillations of a sector of the basin bottom that occur at a specified vertical rate.

The pattern of wave motion and the elements of the generated waves are analyzed as functions of the flow rate, oscillation frequency, density difference, and surface tension. References 11.
[25-1386]

USSR UDC 532.516

NONLINEAR AXISYMMETRIC FLUID FLOW IN SPHERICAL LAYERS

NELINEYNYYE OSESIMMETRICHNYYE TECHENIYA ZHIDKOSTI V SFERICHESKIKH SLOYAKH in Russian, Preprint No 385, Institute of Space Research, USSR Academy of Sciences 1977, 55 pp

ASTAF'YEVA, N. M., VVEDENSKAYA, N. D. and YAVORSKAYA, I. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B90 (annotation)]

[Text] Nonlinear axisymmetric motions of a viscous fluid in spherical layers of specified thickness during the rotation of the inner sphere alone are numerically investigated. The solution is presented in the form of series with respect to associated Legendre functions $P_e^m(\cos\ \theta)$, m = 0.1 with r- and t-dependent coefficients. The variables in the linear parts of the equations are separated, the nonlinear terms are re-expanded with respect to the same polynomials, and the system for the coefficients is solved by the matrix dispersion method. The steady-state solution is ascertained.

In the thin layer, nonuniqueness of steady-state solutions of the Navier-Stokes equations is numerically established and the domains of existence of different flow modes are established (according to their Re numbers). Flow calculations for the thick layer have, along with previously performed experiments, served to conclude flow stability within the range of Re numbers considered.

Stream lines and lines of equal angular velocities are derived, as are the space spectra of kinetic energy and of the discrete velocity components; the total kinetic energy and the angular momentum for various Re numbers are calculated. Comparison with experiment shows good quantitative and qualitative agreement. References 17.
[25-1386]

USSR UDC 534.2:532

FORMATION OF QUASISTEADY-STATE TRAVELING WAVES WITH A PERIODIC STRUCTURE FROM UNSTABLE FLOW OF A BAROTROPIC GAS MOVING UNDER THE ACTION OF NONLINEAR BODY FORCES

OBRAZOVANIYE KVAZISTATSIONARNYKH BEGUSHCHIKH VOLN S PERIODICHESKOY STRUKTUROY IZ NEUSTOYCHIVYKH POTOKOV BAROTROPNOGO GAZA DVIZHUSHCHEGOSYA POD DEYSTVIYEM NELINEYNYKH OB"YEMNYKH SIL in Russian 1977, Preprint No 126, Institute of Applied Mathematics, USSR Academy of Sciences 1977, 78 pp

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B249 (annotation)]

[Text] The conditions of the formation of periodic-structure traveling waves from unstable spatially homogeneous streams of a barotropic gas moving under the action of a nonlinear body force are established. It is shown that violation of one of the stability conditions results in the formation of a wave with a quasiperiodic structure. Monoparametric families of periodic-structure traveling waves, representing an asymptotic stage of the evolution of the developing perturbations are constructed. The effect of viscous dissipation on the structure of the periodic bora type waves is

investigated in detail. The conditions of existence of metastable uniform flow are established. The lengths and propagation rates of stable periodic waves are determined.
[25-1386]

USSR UDC 532.593

ERROR OF THE LINEAR FILTRATION METHOD IN ANALYSIS OF FLUCTUATIONS OF RANDOM FIELDS IN THE ATMOSPHERIC LAYER OVER THE WATER AND IN THE UPPER LAYER OF THE SEA

OKEANOLOGIYA in Russian Vol 8, No 1, 1978 pp 28-34

BENILOV, A. YU.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B35]

[Text] The error of the linear filtration method, used to divide the measured field of fluctuations into components of turbulent and wave origin, is analyzed. The magnitude of that error is estimated as a function of the properties of the space spectrum of surface wave motion. References 11.
[25-1386]

USSR UDC 532.517.4

DETERMINATION OF THE SPECTRUM OF LOCALLY ISOTROPIC TURBULENCE ON THE BASIS OF OPTICAL MEASUREMENTS

OPTIKA I SPEKTROSKOPIYA in Russian Vol 44, No 2, 1978 pp 366-369

KOPILEVICH, YU. I., TIBILOV, A. S. and YAKOVLEV, V. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B157 by the authors]

[Text] The possibility of reconstructing the power spectrum of turbulence from the time characteristics of the photoreceiver signal at the output of an optical system is established for an optical system receiving the luminous field passing through a layer of the investigated random-inhomogeneous medium moving with regulated velocity at right angles to the system's axis for the case in which the permittivity field displays n steady

state increments in coordinates and in time. It is shown to the Born approximation that the relationship between the statistical time characteristics of the photoreceiver signal and the power spectrum of the optical inhomogeneities markedly depends on the statistical hypotheses employed with respect to the optical characteristics of the medium. References 8. [25-1386]

USSR UDC 532.593

INTERNAL WAVES AND THE VERTICAL STRUCTURE OF WATER TEMPERATURE IN THE OCEAN

Vladivostok OSOBENNOSTI STRUKTURY I DINAMIKI VOD TIKHOGO OKEANA [Features of the Structure and Dynamics of the Waters of the Pacific] in Russian 1976 pp 101-117

NAVROTSKIY, V. V.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B37 by the author]

[Text] Numerical simulation of internal waves in the presence of a complex Vaisala frequency profile points to a major role of resonance interactions between different modes of internal waves, different frequencies and wave numbers, and different layers with maximum density gradients. These interactions result in energy fluxes into shortwave perturbations concentrated in thin stable layers as well as in a marked vertical alternation of shortwave amplitudes.

Under these conditions the increase in the vertical coefficient of heat conduction owing to the periodic redistribution of the gradients becomes substantial. Allowance for the effect of internal waves on the effective coefficient of heat conduction in the solution of the equation of heat conduction results in a tendency toward a quasistaggered vertical temperature distribution (zones of increase and decrease in gradients). Numerical solution of the equation for internal waves jointly with the equation of heat conduction with respect to an initial constant temperature gradient shows that the formation of internal waves should result in a staggered structure, a more complex Vaisala frequency profile, and an increase in vertical fluxes of properties in a stably stratified fluid flow. References 17.
[25-1386]

USSR UDC 533.69.011

FEATURES OF SUPERSONIC INTERACTION BETWEEN AN OSCILLATING AIRFOIL AND A SCREEN

Tashkent OSOBENNOSTI SVERKHZVUKOVOGO VZAIMODEYSTVIYA KOLEBLYUSHCHEGOSYA PROFILYA S EKRANOM in Russian, editorial board of IZVESTIYA AN UZBEKSKOY SSR, SERIYA TEKHNICHESKIKH NAUK 1978 manuscript deposited at VINITI 12 Apr 78 No 155--78 Dep, 16 pp

TROFIMOV, V. V.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1236DEP by the author]

[Text] Aspects of the shape and position of bow shock waves in the presence of rotational oscillations of an airfoil moving at supersonic speed in the neighborhood of a screen are experimentally investigated with the aid of N. Ye. Zhukovskiy's gas-hydraulic analogy. The studies were done in a hydraulic channel with a rhomboidal shape having a chord b = 250 mm and flow deflection angle $\theta = 10^{\circ}$ at Mach numbers $M_{\infty} = 1.3\text{-}2.0$, dimensionless oscillation frequencies $p^* = 0.25, 0.4, 0.6, 0.8, 1.0$, oscillation amplitude $\alpha^* = 3^{\circ}$, and rotation-axis position $\bar{x}_{rot} = x_{rot}/b = 0.5$.

Shock wave patterns obtained with measurements of corresponding parameters are presented, the most common types of the resulting bow shocks are isolated, and the causes of the instability of location and deformation of bow shocks are explained. References 6.
[25-J386]

USSR UDC 533.697

ANALYSIS OF THE STABLE PHASE OF THE EFFLUX OF GAS FROM A LONG CYLINDRICAL CHANNEL

Yaroslavl' RASCHET STABIL'NOY FAZY ISTECHENIYA GAZA IZ DLINNOGO TSILINDRICHESKOGO KANALA in Russian 1977 manuscript deposited at VINITI 17 Mar 78 No 962-78 DEP, 21 pp

ISTOMIN, A. N., Yaroslavl' Polytechnical Institute

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1368DEP by the author]

[Text] A procedure for calculating the parameters of gas in a long cylindrical channel during the stable phase of the aftereffect period, with

allowance for the polytropic distribution of these parameters along the channel's length, is described. The efflux process is regarded as quasi-steady. The hypothesis of proportional expansion is employed; on its basis, a linear pattern of distribution of velocities of elements of the gas flow along the channel is derived. The crucial factor in the analysis is the determination of the relative pressure at the outlet. To simplify the calculations, a nomogram for determining this relative pressure is presented. [25-1386]

USSR UDC 533.6.013.42

NUMERICAL INVESTIGATION OF UNSTEADY INTERACTION OF A CYLINDRICAL SHELL WITH A VISCOUS INCOMPRESSIBLE FLUID

Kazan' STATIKA I DINAMIKA OBOLOCHEK [Statics and Dynamics of Shells] in Russian No 8, 1977 pp 137-145

SULEYMANOVA, M. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V500 by the author]

[Text] The finite-difference method is used to investigate on a nonuniform grid the interaction between a soft cylindrical shell and its circumambient fluid. The boundary conditions of contact between the shell and the fluid are satisfied on the deformed surface of the shell. The displacements and rates of motion of the shell's nodes under the action of a shifting load and an external hydrodynamic pressure are determined. References 7. [25-1386]

USSR UDC 533.652/661.013

RESULTS OF A NUMERICAL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF THE WING-FUSELAGE COMBINATION IN THE PRESENCE OF BURBLING

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian,Moscow Aviation Institute No 417, 1977 pp 45-49

CHVATOV, L. V.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1269 by V. I. Putyata]

[Text] The results of calculations of the characteristics of certain configurations of the wing-fuselage system in the presence of burbling on the basis of the method previously proposed by the author (see REFERATIVNYY ZHURNAL, MEKHANIKA, 10B989, 10B990, 1977) are presented. The author points out that the attainment of sufficient accuracy requires a fairly detailed breakdown of separation flow, which entails a corresponding increase in the volume of calculations. The author believes that such analyses cannot entirely replace experimental wind-tunnel research but may prove useful in preliminary blueprint drafting.
[25-1386]

USSR UDC 532.5

DIRECT PROBLEM OF STREAMLINE FLOW AROUND PLANE CONTOURS

Moscow TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 421, 1977 pp 5-13

KOTLYAR, YA. M. and BORISOV, V. YU.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B21 by V.V. Krylov]

[Text] The plane problem of determining the hydrodynamic pressure acting on a smooth contour of the curved-arc type in steady separation flow of an ideal incompressible and weightless fluid is considered. The position of the points of separation of the flow on the contour is assumed to be known.

The problem is solved with the aid of the Levi-Civita method of conformal mapping onto a semicircle the flow region, the complex potential, and the logarithm of complex velocity whose components are the functions in question. The successive approximation method is tentatively used in the solution of the direct problem. The convergence of the iteration processes in the general case has not been investigated by the authors, but certain of the presented calculations on an M-220 computer (in particular regarding the arc of the circle) show that the process of successive approximation converges fairly rapidly.
[25-1386]

USSR UDC 532.5

DEFORMATION OF A FILAMENT IN A FLUID FLOW

Moscow TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 421, 1977 pp 42-49

FEDOROVA, N. M. and GOLUBEVA, T. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B16 by S. I. Kraanov]

[Text] Two-dimensional motion of an ideally flexible extensible and ponderable loop in a fluid flow with an infinitely variable velocity is considered. A system of equations is set up for the deformation of a loop having fixed ends under the action of the forces of gravity and hydrodynamic pressure. Hydrodynamic pressure is derived from a solution of the steady-state problem of streamline flow around a loop having a configuration specified at a specific time instant. The validity of such a formulation and the question of the convergence of the proposed numerical solution are not discussed. The motion of a piecewise-penetrable closed loop with a weight attached to it is similarly modeled. In the example considered the fluid pressure on the loop is assumed to be a specified function of the arc abscissa with a piecewise-linear time factor. It is stated that the calculations point to an oscillatory pattern of motion of the deformable system. [25-1386]

USSR UDC 532.593

INVESTIGATION OF THE DYNAMIC INTERACTION OF A DEFORMABLE BODY AND UNDULATING FLOW, BASED ON FIELD MEASUREMENTS

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian, Scientific Research and Design Institute (of Petroleum) No 14, 1977 pp 46-56

GADZHIYEV, F. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B48 by B. I. Trifontsev]

[Text] The investigation of the motion of a body in an undulating flow is a complex problem of both dynamic and hydroaeromechanical nature. In the case of flow stall and the formation of eddies at incidence upon a poorly streamlined body, the danger of vibrations of structures arises. Considering that certain assumptions of the theory underlying the pertinent

calculations are not confirmed by observations of the behavior of a body in an undulating flow, the author carried out experimental measurements of wave pressure with the aid of a dynamometric device under field conditions. The experiments were performed by the Gipromorneft' Institute on a special rig in the Caspian Sea. The diameter of the dynamometric device was 0.48 m, and it had a wall thickness of 11 mm and an overall length of 14 m. The device was suspended on a platform with allowance for immersion of its free end in the sea to a depth of 8.5 m. Measurements of flexural stresses in the body of the device were performed with the aid of strain gage sensors whose readings were recorded synchronously for wave heights and the bending moment (stress). On the basis of the proposed model for the analysis of the dynamic wave load due to burbling of the undulating wave around the deformable body, as well as on the basis of the processing of field measurement data, the author established a functional relationship between wave pressure and the principal parameters of the deformability of the dynamometric device. The findings are presented in the form of graphs showing fairly close fit between theoretical and experimental data. References 7. [25-1386]

USSR UDC 539.3

HEAT CONDUCTION AND THERMAL STRESSES IN SHELLS IN THE PRESENCE OF ASYMMETRICAL HEATING

TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 1, 1978 pp 123-131

TSOY, P. V.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V199 by M. S. Povarnitsyn]

[Text] An analytic approximate solution of the one-dimensional unsteady-state problem of heat conduction with asymmetrical boundary conditions of the third kind and internal heat release (q_v) is presented with respect to a plate ($\Gamma = 0$), a pipe ($\Gamma = 1$) and a hollow sphere ($\Gamma = 2$) represented by a single equation. The heat conduction equation is, following the application of the Laplace transform in time, solved approximately by the Bubnov method on specifying the solution in the form of a series with a priori selection of linearly independent coordinate functions. Following algebraic calculation in the converted plane of the coefficients in the neighborhood of coordinate functions an inverse transformation is performed. The solution is obtained in the form of a power series in time with coefficients close to the Fourier criterion F_0 and roughly equal to the squares of the roots of the characteristic equations of the exact solutions.

Specific examples are considered with allowance only for the first coordinate of the function--the quadratic trinomial. Solutions for $\Gamma = 0$, $q_v = 0$ are presented; on one side of the plate the temperature of the medium T_m = const, or is an exponential function of time, while on its other side T_m equals the initial temperature. A solution for the cylinder and sphere is also provided ($\Gamma = 1.2$) for q_v = const. The approximate solution is close to the exact when $F_0 \geqslant 0.1$. For initial time instants ($F_0 \leqslant 0.01$) there exist marked divergences from the exact solution. The solutions derived are used in the analysis of thermal stresses with respect to the steady-state value, $q_v = 0$, of the temperature of the ambient heat-transfer medium, once such value is attained exponentially in time. The maximum-time stresses at the surface of the plate, cylinder, and tube at these instants of time are derived. The computational findings are in good agreement with exact solutions. References 6.
[25-1386]

USSR UDC 534.2:532

DIFFRACTION OF SOUND BY CONTACTING ELASTIC BODIES OF SPHEROIDAL SHAPE

TRUDY LENINGRADSKOGO KORABLESTROITEL'NOGO INSTITUTA [Transactions of Leningrad Shipbuilding Institute] in Russian No 117, 1977 pp 25-31

KLESHCHEV, A. A. and MOSYAGIN, A. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B250 by the authors]

[Text] The method of separation of variables is used to solve the problem of the diffraction of sound on an elastic hemispherical semispheroid that is in contact with an elastic half-space and a liquid medium. The contacting surface of the elastic medium is represented by an analytic angular coordinate of an attenuated spheroid. The unknown coefficients of the expansion of potentials with respect to the eigenfunctions of scalar Helmholtz equations are derived with the aid of the Sommerfeld variational method in which the coefficients of interest to this study minimize the total rms error of the calculations. References 8.
[25-1386]

USSR UDC 533.6.013.42

STATISTICAL ANALYSIS OF THE EFFECTIVENESS OF RESONANT RADIATION OF A CYLINDRICAL SHELL SUBMERGED IN WATER

TRUDY LENINGRADSKOGO KORABLESTROITEL'NOGO INSTITUTA [Transactions of the Leningrad Shipbuilding Institute] in Russian No 117, 1977 pp 36-43

BERNBLIT, M. V.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V516]

[Text] A statistical model of the resonant radiation of a bounded cylindrical shell submerged in water is examined. The effectiveness of the radiation is determined over a broad range of subcritical frequencies. It is shown that the equivalent-plate method can also be applied at frequencies below the annular frequency if the "equivalent" plate is construed as an orthotropic structure whose flexural rigidity in one direction coincides with the peripheral rigidity of the shell. The effect of a fluctuating medium on the effectiveness of the radiation is determined through a corresponding conversion of structural wave numbers in water and in vacuo. At frequencies below the peripheral resonance the standard limiting transition to the effectiveness of band radiation of the plate is derived. References 6.
[25-1386]

USSR UDC 534.2:532

WAVE SPECTRA OF A SOURCE IN A RANDOMLY INHOMOGENEOUS MEDIUM

TRUDY LENINGRADSKOGO KORABLESTROITEL'NOGO INSTITUTA [Transactions of the Leningrad Shipbuilding Institute] in Russian No 117, 1977 pp 44-47

KUDASHEV, YE. B., KUSONIN, N. G., RESHETOV, L. A. and STROCHILO, A. G.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B247 by the authors]

[Text] The accuracy of effective estimates of the angular coordinates of an acoustic field source placed in a turbulent medium is investigated. Reception of the field signal against the background of wideband uncorrelated noise is examined. The covariant matrix inversion method is used to show that decorrelation at the wavefront results in an increase in the variance of the estimate. The effect of antenna dimensions, signal/noise ratio, and observation angles on the loss of precision is examined, and the need to allow inhomogeneities is thus indicated.
[25-1386]

USSR UDC 532.5:621.22

CERTAIN ASPECTS OF THE FORMULATION AND INTEGRAL METHOD OF SOLUTION OF THE DIRECT THREE-DIMENSIONAL PROBLEM FOR BLADING SYSTEMS

Moscow TRUDY MOSKOVSKOGO ENERGETICHESKOGO INSTITUTA [Transactions, Moscow Power Institute] in Russian No 337, 1977 pp 14-26

MORGUNOV, G. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1177 by T. S. Solomakhova]

[Text] Further development of the solution of the problem of determining the parameters of steady-state three-dimensional flow of an ideal incompressible fluid in turbomachine rotors is proposed as an improvement on the method proposed earlier by the author (MORGUNOV, G. M., IZV. AN SSSR, MEKH. ZHIDKOSTI I GAZA, No 2, 1974 pp 150-152) for the case of swirled flow around a blade cascade. The solution is determined for an interblade channel with allowance for the vortex sheet forming in the wake behind the blades. An integral equation is set up. An iterative calculational procedure is presented.
[25-1386]

USSR UDC 532.5:532.135

TURBULENT FLOW OF A NEWTONIAN FLUID IN A ROUGH PIPE

TRUDY. SEVERO-KAVKAZSKIY NAUCHNO-ISSLEDOVATEL'SKIY I PROYEKTNYY INSTITUT NEFT'YANOY PROMYSHLENNOSTI [Transactions, North Caucasus Scientific Research and Design Institute of the Petroleum Industry] in Russian No 3, 1976 pp 64-68

AKILOV, ZH. A. and MAMATKULOV, M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B829 by I. G. Bulina]

[Text] The turbulent flow of a viscous fluid in a rough circular pipe is examined. The equations of motion are set up on the basis of the concept of turbulent viscosity. The coefficient of viscosity is determined from a formula used for smooth pipes with allowance for the inhomogeneity of roughness distribution. Formulas for flow rate distribution in the laminar sublayer and in the turbulent region are obtained, as are formulas of mean flow rate and hydraulic drag.
[25-1386]

USSR UDC 533.652/661.013

ANALYSIS OF AERODYNAMIC CHARACTERISTICS OF AIRCRAFT AT SUPERSONIC SPEEDS

Ramenskoye UCHENYYE ZAPISKI TSENTRAL'NOGO AERO-GIDRODINAMICHESKOGO INSTITUTA [Scientific Annals of the Central Aero-Hydrodynamic Institute] in Russian Vol 9, No 1, 1978 pp 11-18

KUDRYAVTSEVA, N. A. and LAVRENKO, N. G.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1256]

[Text] The Method for and results of the calculation of the aerodynamic characteristics of aircraft in the presence of steady-state motion and variation of kinematic parameters of motion (angle of attack α, angular velocities ω_z, ω_x, general deformation δ_1) in accordance with harmonic laws, with the Strouhal numbers tending toward zero, are described. The velocity potential ϕ of sources located in a single base plane is determined. The accuracy of calculations of aerodynamic characteristics based on the reversibility theorem is compared with experimental findings, as are the calculations of loads, forces, and moments. References 14.
[25-1386]

USSR UDC 533.69.011

OPTIMAL AIRFOILS IN SUPERSONIC FLOW WITH SPECIFIED AREA AND STABILITY MARGIN

Ramenskoye UCHENYYE ZAPISKI TSENTRAL'NOGO AERO-GIDRODINAMICHESKOGO INSTITUTA [Scientific Annals of the Central Aero-Hydrodynamic Institute] in Russian Vol 9, No 1, 1978 pp 19-24

NIKOLAYEV, V. S.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1235]

[Text] A number of variational problems of the optimal shape of a slender airfoil in linearized supersonic flow is considered. The length of the chord and the area of the airfoil are taken to be specified. The position of the center of mass of the airfoil is taken to coincide with its geometric center of inertia as well as--proceeding from the balancing condition--with the position of the center of pressure. The static stability margin also is specified. Shapes of the lower and upper surfaces of an airfoil with sharp leading and trailing edges are determined insofar as such shapes correspond to minimum wave drag in the presence of a given lift or to a maximum value of aerodynamic quality.
[25-1386]

USSR UDC 533.9

STABILITY OF PLASMA WITH A NEGATIVE COLLISION CONDUCTION

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 23, No 4, 1978 pp 597-600

BRODSKIY, V. B.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B408 by the author]

[Text] The electron concentration distribution in a weakly ionized plasma with negative collision conduction is determined. The equilibrium condition is taken as the zero sum of the electron diffusion current and the electron conduction current due to the space charge. This is used to derive the electron concentration distribution symmetrical with respect to the z = 0 plane on condition that the elastic collision frequency of the electrons markedly exceeds the plasma frequency. The characteristic dimension of the region in which the electron concentration markedly differs from its mean turns out to be of the order of the Debye radius. The power of the external energy source needed to maintain plasma in an equilibrium state with negative conduction is estimated.
[25-1386]

USSR UDC 533.69.011

EVALUATION OF THE DESIGN MODIFICATIONS OF A TRIPLE-SECTION FLAP ON THE BASIS OF WIND TUNNEL TEST DATA

VOPROSY PROYEKTIROVANIYA LETATEL'NYKH APPARATOV [Problems of the Design of Flight Vehicles] in Russian No 1, 1977 pp 19-23

MATYAZH, A. I. and KSENOFONTOVA, YE. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1252]

[Text] Wind-tunnel test findings on various modifications of a slotted flap are analyzed. Test data are processed on the basis of a generalized geometrical parameter--the adjusted angle of deflection of the flap.

The dependences of the increments in the aerodynamic coefficients C_x, C_y, m_z and quality K on the adjusted angle of deflection of the flap are approximated by means of analytic formulas. The numerical coefficients of the equations are determined and practical recommendations for the selection

of particular modifications of the flap depending on various flight-mode requirements are given.
[25-1386]

USSR UDC 533.69.011

APPROXIMATION OF AIRFOIL SURFACE BY MEANS OF ORTHOGONAL POLYNOMIALS

VOPROSY PROYEKTIROVANIYA LETATEL'NYKH APPARATOV [Problems of the Design of Flight Vehicles] in Russian No 1, 1977 pp 21-29

NUGMANOV, Z. KH.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978, Abstract No 8B1242 by the author]

[Text] A two-parameter formulation of the surface of a finite-span airfoil is presented. The surface equation is derived to an approximation in the form of a series with respect to an orthogonal system of functions whose coefficients depend on another parameter. Allowance is also made for possible rounding of the forebody or the trailing section of the airfoil, and a formula describing the airfoil's extremities is presented. References 8.
[25-1386]

USSR UDC 533.69.011

DETERMINATION OF THE LOCUS OF EDDY COLLAPSE ON AN AIRFOIL WITH A LOW ASPECT RATIO

VOPROSY PROYEKTIROVANIYA LETATEL'NYKH APPARATOV [Problems of the Design of Flight Vehicles] in Russian No 1, 1977 pp 29-36

TRUNEVA, E. A. and CHEREMUKHIN, G. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1232 by the authors]

[Text] The findings of an investigation of the collapse of an eddy in flow around an airfoil with a low aspect ratio are presented. Experimental formulas for determining the locus of collapse of the eddy above the airfoil surface are derived. The formulas are recommended for application in design calculations. References 8.
[25-1386]

High-Energy Devices, Optics and Photography

USSR UDC 533.9

ANALYSIS OF THE CHARACTERISTICS OF A CO_2-N_2-CO-H_2O-H_2 GAS-DYNAMIC LASER

RASCHET KHARAKTERISTIK CO_2-N_2-CO-H_2O-H_2 GAZODINAMICHESKOGO LAZERA in Russian Preprint No 99, Institute of Problems of Mechanics, USSR Academy of Sciences 1977, 48 pp

KOZLOV, G. I. and IVANOV, V. N.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B360 by O. P. Shatalov]

[Text] The characteristics of a gas-dynamic CO_2 laser are analyzed over a broad range of temperatures (up to 3000 K) and pressures (up to 60 atm) in the presence of CO and H_2 components in the gas mixture. Chemical reactions were not considered, and a system of equations containing 18 vibrational energy exchange channels in a 5-component gas mixture was examined. The data on vibrational relaxation in this gas mixture are analyzed, the reaction rate constants selected for use in the calculations are substantiated and basic equations of quasi-one-dimensional motion of the relaxing gas mixture are set up (assuming the existence of local Boltzmann population distribution within each vibrational mode); an exact system of equations describing the rotational energy balance in the system of relaxing molecules considered as harmonic oscillators is presented. The principal formulas used to compute the amplification factor of radiation by the laser mixture are discussed. Calculations of the parameters of nonequilibrium flow are done by an implicit method in the supersonic flow region with boundary conditions derived from the solution for equilibrium flow. The calculations were done for plane logarithmic nozzles. In addition to the change in the pressure and temperature of gas in the forechamber, the calculations allowed for the variation in the concentration of ingredients, for the height of the critical cross section, and for the degree of expansion of gas in the nozzle. The vibrational temperature distribution along the nozzle and the distribution of the weak signal gain were derived; the effect of computational parameters on these characteristics was analyzed, and the gain was optimized. Assuming constancy of the radiation intensity within the resonator of the gas-dynamic laser, lasing power was calculated, the pattern of variation in power along the resonator was analyzed, and its relationship to the reflection coefficient of the mirrors and to the composition of the mixture was investigated. It is shown that the optimal mixture compositions from the standpoint of maximizing gain and unit power are not constant, and that their variation increases with increase in pressure. References 45.
[25-1386]

USSR UDC 533.9

CHARACTERISTICS OF AN ANODIC-LAYER TWO-STAGE ION ACCELERATOR

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian No 2, 1978 pp 28-36

GRISHIN, S. D., YEROFEYERV, V. S., ZHARINOV, A. V., NAUMKIN, V. P. and SAFRONOV, I. N.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B363 by the authors]

[Text] The design of an annular anodic-layer two-stage accelerator operating on bismuth is described. The findings of an experimental investigation of the accelerator's characteristics are presented. At high accelerating voltages ($V_y > 2$ kV) an optimal acceleration mode is observed; then the current I_i ($I_y \approx I_i$). In this mode, well-formed ion beams with current intensity of from 2 to 15 A have been obtained. The mean-mass ion velocity is independent of the current and is directly proportional to the square root of voltage, which points to an electrostatic nature of acceleration. The acceleration efficiency is ≈ 0.8. As the acceleration voltage decreases, the shaping of the ion beam deteriorates, and in some cases a sharp transition from the acceleration mode to an anomalous mode at which I_y may markedly exceed the consumption of the working medium is also observed. The effect of the first (discharge) stage of the accelerator and of the magnitude of the magnetic field on the characteristics is considered. The operating range of discharge voltages is a function of the magnitude of the accelerating voltage and of the accelerated ion current and ranges over 100-500 V. References 19.
[25-1386]

Industrial Technology

USSR UDC 531.8

PROBLEMS OF THE SYNTHESIS OF ROBOT AND MANIPULATOR MECHANISMS

SBORNIK NAUCHNO-METODOLOGICHESKIKH STATEY PO TEORII MEKANIZMOV I MASHIN [Collection of Scientific-Methodological Articles on the Theory of Mechanisms and Machinery] in Russian, USSR Ministry of Higher and Secondary Special Education No 7, 1978 pp 22-28

VOROB'YEV, YE. I.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A190 by the author]

[Text] The problem of synthesis of the actuating mechanisms of all-purpose robots and manipulators is considered, and is formulated as a problem of the optimization of quantitative indicators and characteristics of the mechanism in the presence of constraints. The solution of the problem is divided into stages of structural, kinematic, and dynamic synthesis. References 10.
[25-1386]

USSR UDC 531.8

ASPECTS OF THE INTRODUCTION OF INDUSTRIAL ROBOTS IN COLD BLANKING SHOPS

Irkutsk UPRAVLYAYEMYYE MEKHANICHESKIYE SISTEMY [Controllable Mechanical Systems] in Russian 1977 pp 190-197

KUZNETSOV, N. K. and KHVOSHCHEVSKIY, G. I.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A191 by the authors]

[Text] The results of the introduction of the PR-10I industrial robot for the automation of the processes of blanking sheet parts are discussed. The effect of operating modes on the precision of functioning of the robot is assessed.
[25-1386]

Mechanics of Solids

USSR UDC 539.3:534.1

FORCED AXISYMMETRIC VIBRATIONS OF A ZERO-MOMENT SHELL OF REVOLUTION WITH ALLOWANCE FOR INTERNAL FRICTION

Irkutsk ASIMPTOTICHESKIYE METODY V TEORII SISTEM [Asymptotic Methods in Systems Theory] in Russian 1977 pp 17-25

ULITIN, M. I.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V311 by A. A. Kozlova]

[Text] A system of equations describing steady-state forced axisymmetric vibrations of a thin shell of revolution is presented with allowance for internal friction in the material. The external force is presumed to be specified in the form of a harmonic function. A solution for frequencies outside the continuous-spectrum zone is derived with and without allowance for damping. In the example considered the amplitude-frequency characteristic of normal displacement of a point of the median surface in the presence of axisymmetric vibrations of a cylindrical shell is determined. [25-1386]

USSR UDC 539.3:534.1

STABILITY OF A TRUNCATED CONICAL SHELL UNDER A TRANSVERSE BENDING FORCE AND MOMENT

Moscow DEFORMIROVANIYE I RAZRUSHENIYE TVERDYKH TEL [Deformation and Fracture of Rigid Bodies] in Russian 1977 pp 3-9

LOKOSHCHENKO, A. M. and SHESTERIKOV, S. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V423 by A. V. Sachenkov]

[Text] The stability of a hinged elastic truncated conical shell under the combined action of a bending moment and a transverse force applied to its small end is examined from the standpoint of the theory of shallow shells in a linear formulation. The initial state is considered to be zero-moment. The solution of the problem is accomplished by the Bubnov method, using an approximation in the form of trigonometric polynomials for the function of stresses and flexure. Critical-load formulas are derived for particular

cases of loading. No computational results are given or compared with experimental findings. References 5.
[25-1386]

USSR UDC 539.3:534.1

VIBRATIONS OF A REINFORCED PLATE WITH MOVING LOADS

DINAMIKA I PROCHNOST' MASHIN. RESPUBLIKANSKIY MEZHVEDOMSTVENNYY NAUCHNO-TEKHNICHESKIY SBORNIK [Dynamics and Strength of Machinery. Republic Interdepartmental Scientific and Technical Collection] in Russian No 27, 1978 pp 64-70

DEM'YANENKO, A. G., KIBA, S. P. and CHIZHOV, G. G.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V322 by A. A. Kozlova]

[Text] The vibrations and stability of rectangular plates reinforced with stiffeners in the longitudinal direction and carrying a shifting flow of inertial materials are investigated. Differential equations of motion are set up for a structurally orthotropic plate with discrete positioning of stiffeners, with allowance for the Coriolis forces of inertia of the moving mass and the structure. The equations contain mixed derivatives of time and coordinate, and a complex function of displacements is introduced for their solution. A solution for freely supported edges is obtained. The effect of flow rate and number of stiffeners on the natural frequencies of the plate is investigated. It is shown that increasing the flow rate of the transported material reduces the natural frequencies of transverse oscillations and that, once a certain flow rate is reached, static instability of the system is reached. If the flow rate is increased still further, dynamic instability of the system sets in.
[25-1386]

USSR

MATHEMATICAL MODEL OF THE ELASTIC ENCLOSURE OF HYDRAULIC ELEMENTS

Novosibirsk GIDROPRIVOD I SISTEMY UPRAVLENIYA [Hydraulic Drive and Control Systems] in Russian 1977 pp 31-35

KIRIKOV, R. P., SHCHERBAKOV, V. S. and SHERMAN, E. B.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V310 by V. I. Mamay]

[Text] A mechanical model of an elastic shell is analyzed with the object of investigating the dynamic behavior of elastic components of hydraulic machinery in the form of shells. The model represents a system of local masses distributed along the median surface of the shell and linked by elasto-viscous Kelvin-Voigt elements. Formulas for the kinetic and potential energies as well as for the dissipative component of the energy of the proposed model are presented. The general form of the equations that can be derived from the presented formulas with the aid of a Lagrange equation of the second kind is given.
[25-1386]

USSR UDC 539.3

CALCULATIONS OF A CLOSED CIRCULAR TOROIDAL SHELL UNDER CYCLIC LOADING WITH THE VARIABILITY INDEX $t > 1/2$

GODISHN. VYSSH. UCHEBN. ZAVED, PRILOZH. MAT. in Bulgarian Vol 11, No 3, 1975 (1977) pp 151-157

PETROVA-DENEVA, A. I. and MILUSHEVA, S. D.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V194 by V. I. Kruglyakova]

[Text] The problem of a circular closed toroidal shell under external loading with a high variability index is solved. A particular solution of the inhomogeneous equation is derived by the asymptotic integration method. Torus sections with positive and negative gaussian curvature are separately considered. The solution of the homogeneous equation (for the fundamental state and the edge effect) is written to a first approximation.
[25-1386]

USSR UDC 539.3

BENDING OF INFINITE PLATES REINFORCED WITH RECTILINEAR ELASTIC STIFFENERS AND RESTING ON AN ELASTIC BASE

Odessa IZGIB NEOGRANICHENNYKH PODKREPLENNYKH PRYAMOLINEYNYMI UPRUGIMI REBRAMI PLASTIN NA UPRUGOM OSNOVANII in Russian 1977 manuscript deposited at VINITI 29 Nov 77 No 4364-77 Dep. 27 pp

PROTSEROV, YU. S., Odessa University

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V248DEP by A. A. Uspenskiy]

[Text] The Fourier integral transform method is used to solve the problem of the bending of infinite reinforced elastic plates under a transverse load. Cases of reinforcement of the plates with a single stiffener with several parallel stiffeners and with an intermittent system of parallel infinite elastic stiffeners are considered, as are cases of the reinforcement of a plate with two perpendicular and two mutually perpendicular intermittent systems of elastic stiffeners. The contact between the plate and the base is presumed to be smooth, and the stressed state in the plate is not taken into account. The solution of the problem is based on the model of an elastic isotropic half-space and a Winkler base. The solution of the first three problems is found in quadratures, while the solution of the last two problems is reduced to a system of Fredholm integral equations of the second kind. Sample calculations of stiffened plates are presented. References 9. [25-1386]

USSR UDC 531

SYSTEMATIC DEVIATIONS OF A HEAVY RIGID BODY IN A MAGNETIC FIELD IN THE PRESENCE OF VIBRATIONS OF ITS FULCRUM

IZVESTIYA AN SSSR. MEKHANIKA TVERDOGO TELA in Russian No 2, 1978 pp 11-14

DEGTEREV, N. D. and PONYRKO, S. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A67 by the authors]

[Text] Systematic deviations from equilibrium position in the presence of vibrations of the fulcrum are investigated for a rigid body with a single point of support and a magnetic moment, on the basis of a consideration of the spatial pattern of motion in gravitational and magnetic fields. The

relationships between the deviations and the system parameters and vibrations are established, and an estimate of deviations for a specified magnetic measuring system is presented. References 5.
[25-1386]

USSR UDC 539.3:534.1

ON THE PROBLEM OF INTERNAL RESONANCES IN THE THEORY OF THE OSCILLATIONS OF THIN SHELLS

K PROBLEME VNUTRENNYKH REZONANSOV V TEORII KOLEBANIY TONKIKH OBOLOCHEK in Russian, Preprint, Institute of Problems of Mechanics, USSR Academy of Sciences 1977, 51 pp

DAIN, YE. A., LUKOVENKO, S. A. and KHAR'KOVA, N. V.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V287 by V. P. Chirkov]

[Text] The eigenvalue problem is investigated for a system of differential equations describing axisymmetrical moment oscillations of a thin shell of revolution. Asymptotic formulas for the characteristic elements are presented. Special attention is given to investigating the internal resonance effect, defined as the coincidence between the normal mode of predominantly flexural oscillations and the zero-moment form. Numerical findings illustrating the internal resonance effect for conical and toroidal shells are presented. References 7.
[25-1386]

USSR UDC 539.214:539.374

STRESSED STATE OF A THICK WALLED CYLINDER OF AN ISOTROPIC AND ORTHOTROPIC MATERIAL UNDER LOADING BY INTERNAL PRESSURE, AXIAL FORCE, AND TORQUE EXCEEDING THE ELASTIC LIMIT

Kuybyshev K VOPROSU O NAPRYAZHENNOM SOSTOYANII TOLSTOSTENNOGO TSILINDRA IZ IZOTROPNOGO I ORTOTROPNOGO MATERIALA, NAGRUZHENNOGO VNUTRENNYM DAVLENIYEM, OSEVOY SILOY I KRUTYASHCHIM MOMENTOM ZA PREDEL UPRUGOSTI in Russian manuscript deposited at VINITI 18 Apr 78 No 1307-78 Dep. TRUDY NAUCHNO-TEKHNICHNOY KONFERENTSII FAKUL'TETA MATEMATICHESKIKH ZNANIY, POSVYASHCHENNOY 60-LETIYU VELIKOGO OKTYARBRYA [Proceedings of the Scientific and Technical Conference of the Faculty of Mathematical Sciences Devoted to the 60th Anniversary of the October Revolution] 1978, pp 23-28

NIKITIN, O. YA., Kuybyshev Polytechnic Institute

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V551DEP by the author]

[Text] The investigation of the stressed state of a thick walled cylinder of an isotropic and orthotropic material under the load of internal pressure, axial force, and torque, is of considerable interest. The findings of such an investigation would be of practical interest to, e.g. the petroleum industry. One possible way of solving this problem is considered, on condition that the material of the cylinder (isotropic or orthotropic) is linearly strain hardenable, and that the overloads beyond its elastic limit are insignificant. Initial equations for determining the pertinent stresses and forces are presented, stress and strain formulas are derived, and ways of their practical implementation (construction of load limit diagrams) are outlined. References 8.
[25-1386]

USSR UDC 539.3

THERMAL STRESSES IN A CIRCULAR MULTI-LAYERED PLATE

Kiev MATEMATICHESKIYE METODY V TERMOMEKHANIKE in Russian 1978 pp 41-50

KOLESOV, V. S., VLASOV, N. M. and PROTSYUK, B. V.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V230 by the authors]

[Text] The thermoelasticity problem is solved for a circular multi-layered plate whose upper surface is heated by a luminous flux of constant intensity.

The physico-mechanical characteristics of the plate's material are represented by asymmetrical unitary functions. The temperature field in 5- and 9-layer plates and the stresses in the 9-layer plate with its rim held in either fixed or hinged position are investigated.
[25-1386]

USSR UDC 539.3

RECIPROCITY THEOREM AND THE DYNAMIC PROBLEM OF THE THERMODIFFUSION OF THIN TRANSVERSALLY ISOTROPIC SHELLS

Kiev MATEMATICHESKIYE METODY I TERMOMEKHANIKA [Mathematical Methods and Thermomechanics] in Russian 1978 pp 63-71

SHVETS, R. N. and RAVRIK, M. S.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V187 by the authors]

[Text] On the basis of physical relationships and equations of thermodiffusion of thin transversally isotropic shells, the reciprocity law for the dynamic problem of thermodiffusion is presented with allowance for the physico-chemical processes occurring in the system comprising the body and the medium. The reciprocity theorem is used as the basis for determining generalized displacements as well as integral values of temperature and chemical potential in the shell due to specific external sources.
References 9.
[25-1386]

USSR UDC 539.3

OPTIMAL TEMPERATURE FIELDS AND STRESSES IN AN INHOMOGENEOUS SPHERICAL SHELL

Kiev MATEMATICHESKIYE METODY V TERMOMEKHANIKE [Mathematical Methods in Thermomechanics] in Russian 1978 pp 78-84

BESEDINA, L. P. and IVANCHUK, YU. G.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V169]

[Text] The problem of determining the extermal local temperature fields and stresses constant over the thickness of a meridionally inhomogeneous closed spherical shell is solved on the basis of variational methods with

minimization of the energy functional of elastic deformation. Optimal temperature fields localized in the equatorial region are determined and investigated, as are the corresponding stresses in a piecewise-homogeneous spherical shell composed from two half-spheres of materials with different characteristics. References 8.
[25-1386]

USSR UDC 624.07:534.1

EFFECT OF THE VARIATION IN THE LEVEL OF LOAD APPLICATION ON THE FREQUENCIES AND MODES OF FLEXURAL-TORSIONAL OSCILLATIONS OF BEAMS

MEKHANIKA STERZHNEVYKH SISTEM I SPLOSHNOY SREDY in Russian No 10, 1977 pp 51-58

BEYLIN, YE. A. and KILIMOV, V. I.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V361 by the authors]

[Text] Flexural-torsional oscillations of thin-walled beams under a parametric load whose level of application along the height of the cross section does not coincide with the beam axis are considered. The solution is obtained by the Bubnov method. A distinguishing feature of the specially constructed approximation function of the angle of twist is that that function automatically varies the modes of free vibrations and the buckling under planar flexure with variation in the magnitude and level of application of the load. Estimates of applicability limits are given for previous results in which the forms of buckling and the modes of free vibrations of loaded and unloaded beams are taken to be identical.
[25-1386]

USSR UDC 539.3:534.1

NONAXISYMMETRIC BUCKLING OF SHALLOW SPHERICAL SHELLS

MEKHANIKA STERZHNEVYKH SISTEM I SPLOSHNYKH SRED in Russian No 10, 1977 pp 64-70

VOL'MIR, A. S. and NOVIKOVA, G. P.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V419 by V. I. Mamay]

[Text] The Papkovich version of the Bubnov method is used to investigate nonlinear non-axisymmetric buckling of shallow spherical shells under a uniform external pressure that varies linearly in time. The investigation is based on K. Margerre's equations with allowance only for transverse inertia. The normal bending flexure of the shell is approximated by the equation $w = (\rho^2-1)^2 x (a_1+a_2)^4 \cos n\phi$, where ρ is the dimensionless instantaneous radius in the plan projection; ϕ is the polar angle; n is the number of waves along the periphery. The solution of the equation of the compatibility of deformations is sought following the substitution of the adopted formula for w in the form $\phi = \sum_{k=0}^{\infty} \phi_k(\rho) \cos k\phi$. The solution for the case k = 0 is presented. Plots of the time dependence of the amplitude coefficients a_1 and a_2 of the approximation formula for the bending flexure are given. It is concluded that, beginning with some parameter of its geometry, the shell buckles asymmetrically.
[25-1386]

USSR UDC 539.3:534.1

STABILITY OF STRUCTURALLY SEMI-MOMENTLESS SHELLS

MEKHANIKA STERZHNEVYKH SISTEM I SPLOSHNYKH SRED in Russian No 10, 1977 pp 86-92

GEYZEN, R. YE.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V424 by V. V. Kabanov]

[Text] The stability of circular cylindrical shells assembled from discrete narrow strips linked by hinges is investigated. Shells of this type are termed transversely semi-momentless shells. On deformation they withstand peripheral bending moments and display features characteristic of rods. It

is shown that, by contrast with continuous-surface isotropic shells, in transversely semi-momentless shells the critical compressive stress is more greatly affected by the edge-clamping arrangement and the critical external pressure is independent of the extent of constraints on longitudinal displacement of edges.
[25-1386]

USSR UDC 539.3

STRESS-STRAIN STATE OF A TOROIDAL SHELL IN THE ELASTIC REGION UNDER A UNIFORM PRESSURE LOAD

Moscow NAPRYAZHENNO-DEFORMIROVANNOYE SOSTOYANIYE TOROIDAL'NOY OBOLOCHKI, NAGRUZHENNOY RAVNOMERNYM DAVLENIYEM, V UPRUGOY OBLASTI in Russian 1978 manuscript deposited at VINITI 25 Apr 78 No 1447-78 Dep, 19 pp

AVDONIN, A. A., Moscow Aviation Institute

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V193DEP by the author]

[Text] The findings of an analysis of the stress-strain condition of toroidal shells with elliptical or circular cross section under a pressure load are presented. Formulas of the linear moment theory of thin elastic shells are employed. The resolvent is derived from the condition of minimum total potential energy. On the basis of finite-difference approximation of the formula for the shell's energy, transition to the problem of nonlinear programming is accomplished; this problem is solved with the aid of an algorithm for the conjugate-gradient method.

The applicability of equations of zero-moment theory to the description of the stressed state of toroidal shells with elliptical or circular cross section is discussed. References 5.
[25-1386]

USSR UDC 531

INVESTIGATION OF THE STABILITY OF UNPERTURBED MOTION OF AN AXISYMMETRIC RIGID BODY IN THE CASE OF SPATIAL MOVEMENT OF ITS CENTER OF MASS IN AIR

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 42, No 2, 1978 pp 355-359

BELYAYEVA, S. D.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A63 by the author]

[Text] The free motion of an axisymmetric body is examined with allowance for the spatial movement of its center of mass along a curve of double curvature, as well as for rotational movement about it. In the equations of motion allowance is made for the air drag, the normal force, the Magnus force, the weight of the body, and also for the destabilizing (stabilizing) moment, the Magnus-force moment, and the damping axial and equatorial moments. The author formulates the conditions which must be satisfied so that over the desired interval of time the deviations of the axis of symmetry of the body from the tangent to the trajectory of its center of mass will not exceed specified values. References 5.
[25-1386]

USSR UDC 539.3

ANALYSIS OF FORMULATIONS AND SOLUTION OF THE PROBLEM OF THE INTERACTION OF COAXIAL SHELLS OF REVOLUTION WITH AN ELASTIC LAYER

PRIKLADNYYE PROBLEMY PROCHNOSTI I PLASTICHNOSTI in Russian No 7, 1977 pp 47-54

LIPOVTSEV, YU. V. and OSAULENKO, V. N.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V176 by the authors]

[Text] Contact stresses in the zone of linkage between the shells and the layer are determined by means of a numerical solution of the coupled system of equations of the general theory of non-shallow shells and of certain approximation equations of the layer. The equations are derived by examining several models of work of the layer and performing their comparative analysis. References 8.
[25-1386]

USSR UDC 539.3:534.1

OSCILLATIONS OF A RECTANGULAR PLATE WITH ADHESIVE-BONDED STIFFENERS

PRIKLADNYYE PROBLEMY PROCHNOSTI I PLASTICHNOSTI in Russian No 7, 1977 pp 127-129

DMITRIYEVA, L. M. and ZHIGALKO, YU. P.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V324 by the authors]

[Text] Free oscillations of a hinge-supported rectangular plate with stiffeners that are cemented parallel to one of its sides are considered. The equations of motion of the stiffened plate are derived from three-dimensional equations of motion of an elastic body by adopting the known Bernoulli-Euler and Kirchhoff-Love hypotheses. The adhesive layer is assumed to be thin, compression and shear are assumed to be constant over its thickness, and the inertial properties of the adhesive are disregarded. The equations are solved for a plate with a single stiffener. Frequency calculations are presented. The effect of the thickness of the adhesive layer on the variation in the oscillation frequencies of the fundamental mode of the plate is demonstrated.
[25-1386]

USSR UDC 539.3

ANALYSIS OF AIRCRAFT STRUCTURES OF THE STIFFENED SHELL OF REVOLUTION TYPE BY MEANS OF STEPWISE APPROXIMATION

Moscow RASCHET AVIATSIONNYKH KONSTRUKTSIY TIPA PODKREPLENNYKH OBOLOCHEK VRASHCHENIYA S POMOSHCH'YU STUPENCHATOY APPROKSIMATSII in Russian 1978 manuscript deposited at VINITI 17 Apr 78 No 1292-78 DEP, 16 pp

ZOTOV, A. A., Moscow Aviation Institute

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V173DEP by the author]

[Text] A numerical analysis of structures of the fuselage type under any load system, speaking in general, is presented.

The internal forces or moments are approximated by a step function in one direction and a continuous series with constant coefficients in the other, and is written in analytic form with the aid of Heaviside functions. The

other force factors are derived from the conditions of equilibrium of the shell element. The problem reduces to determining the coefficients of the approximating series from the condition of the energy minimum of the system.

Sample calculations and the findings of anumerical investigation of the rate of convergence of the solution are presented.
[25-1386]

USSR UDC 531.001

CERTAIN CASES OF MOTION OF A ROTATING ELLIPSOID WITH A VERTICAL AXIS

Moscow SBORNIK PO VOPROSAM MEKHANIKI I PRIKLADNOY MATEMATIKI [Anthology on Problems of Mechanics and Applied Mathematics] in Russian No 9, 1977 pp 61-66

MYNBAYEVA, S. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A39 by the author]

[Text] The motion of a rapidly rotating ellipsoid in a medium with drag is examined. The ellipsoid's axis of rotation is vertical. Equations of the trajectories of motion of the ellipsoid's center of inertia are derived. References 5.
[25-1386]

USSR UDC 531.001

CASE OF THE MOTION OF A ROTATING ELLIPSOID WITH A HORIZONTAL AXIS

SBORNIK PO VOPROSAM MEKHANIKI I PRIKLADNOY MATEMATIKI [Anthology on Problems of Mechanics and Applied Mathematics] in Russian No 9, 1977 pp 83-89

MYNBAYEVA, S. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A40 by the author]

[Text] The motion of a spinning ellipsoid in a medium with drag is considered. The axis of rotation of the ellipsoid is horizontal. Assuming

that major axis of the ellipsoid varies in time in accordance with linear-fractional, linear, and exponential laws during motion, the author derived equations of the ellipsoid's trajectories of motion. References 5. [25-1386]

USSR

UDC 531.8

SUBSTANTIATION OF THE TRAJECTORY OF THE FULCRUM AND CERTAIN POSSIBILITIES FOR DEVELOPING THE LEG MECHANISM OF A WALKING TRANSPORTER

SBORNIK PO VOPROSAM MEKHANIKI I PRIKLADNOY MATEMATIKI in Russian No 9, 1977 pp 209-211

MURATOV, A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A192 by the author]

[Text] The shape of the trajectory of the leg fulcrum for walking on 4 and 8 legs is substantiated. The possibility of developing such a class-5 third-order mechanism is discussed.
[25-1386]

USSR

UDC 624.07:534.1

DETERMINATION OF THE CHARACTERISTICS OF A SYSTEM OF PARTIAL DIFFERENTIAL EQUATIONS DESCRIBING THE MOVEMENT OF AN ELASTIC FILAMENT IN SPACE

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 398, 1977 pp 73-77

TIKHONOV, V. S.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V377 by A. V. Korovaytsev]

[Text] A Cartesian coordinate system is introduced to derive a system of equations describing the motion of a flexible filament in space. On the basis of geometric relations an equation of the distribution of the rates of motion of points on the filament along its length is set up on the assumption of elastic stretching of the filament. An equation of dynamic equilibrium of a filament element is derived on the basis of D'Alembert's principle.

The projection of vector relations on the axes of the coordinate system employed is used to derive a system of six scalar quasilinear partial differential equations. The characteristics of the system are investigated. By means of the solution of a sixth-degree algebraic equation with non-zero coefficients for even-numbered degrees it is shown that the derived system of equations is not hyperbolic strictly speaking.
[25-1386]

USSR UDC 539.3

THERMOELASTICITY OF ANNULAR PLATES OF VARIABLE THICKNESS

TEMATICHESKIY SBORNIK NAUCHNYKH RABOT [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 416, 1977 pp 23-28

ANDRIANOV, N. N. and POPOVICH, V. YE.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V242 by V. G. Rekach]

[Text] The solution of the polar-symmetrical problem of the stress-strain state of a thin annular plate of variable thickness that is nonuniformly heated over its radius, is presented. With the aid of the Duhamel-Neuman equation the problem is reduced to a second-order differential equation with variable-coefficients relative to radial displacement, whose solution is constructed by the method of successive approximation with the aid of power-law polynomials.

A computer program has been compiled for the numerical computation of the displacements and normal forces, and a comparison has been made with the results of known exact solutions of certain boundary-value problems of similar type.
[25-1386]

USSR

UDC 539.3:534.1

FREE OSCILLATIONS OF A CONICAL PANEL

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 418, 1977 pp 57-61

KOSTROV, V. I.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V293 by Ye. A. Lopanitsyn]

[Text] The method of successive approximations is used to solve the problem of the free linear oscillations of a thin shallow conical panel. The equations of the oscillations, written in terms of displacements, allow for oscillations of the panel in the longitudinal, peripheral and transverse directions.

During the first stage of the solution for given boundary conditions on the straight edges, the distribution of flexures with respect to the peripheral coordinate is taken to follow the cosine law. On this basis as well as with the aid of the Bubnov method, the partial equilibrium equations are reduced to a system of ordinary differential equations relative to the longitudinal coordinate, which is solved by the finite-difference method for specified boundary conditions on the curved edges. During the second stage the distribution of flexures with respect to the peripheral coordinate is assumed to be unknown, while the distribution of flexures with respect to the longitudinal coordinate is taken from the preceding approximation. The Bubnov method is again used; this results in a system of ordinary differential equations relative to the peripheral coordinate, which also is solved by the finite-difference method, but for specified boundary conditions on the straight edges. Next, the more precisely determined distribution of flexures with respect to the peripheral coordinate is used to perform another conversion to the longitudinal coordinate with the aid of the Bubnov method, and so on.

This method is used in the solution of cases of hinged and rigid clamping of edges of the panel.
[25-1386]

USSR UDC 539.3:534.1

CONICAL TRUNCATED SHELL UNDER LONGITUDINAL IMPACT: CRITICAL VELOCITY

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 418, 1977 pp 61-65

RYABOV, I. P.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V292 by Ye. A. Lopanitsyn]

[Text] The Bubnov method is used to find the critical velocity of the mass impacting against the smaller base of a freely supported thin shallow truncated conical shell. No allowance is made for surface displacement and local deformations in the impact zone. Plots of the dependence of critical rate on the parameters of wave formation in the longitudinal and peripheral directions are presented.
[25-1386]

USSR UDC 624.07:534.1

APPLICATION OF THE BUBNOV-GALERKIN METHOD TO THE SOLUTION OF THE PROBLEM OF THE DEFORMATION OF A HEAVY INEXTENSIBLE FILAMENT

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 421, 1977 pp 49-54

ZUYEVA, T. F. and OBERTYNSKAYA, YE. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V376 by A. V. Korovaytsev]

[Text] The planar motion of a heavy inextensible unattached closed filament under the action of a concentrated force applied to the ends of the filament, and of a pressure that is symmetrically distributed relative to the line of action of this force, is considered. A Cartesian coordinate system is introduced to describe the motion. The shape of the thread is determined with the aid of equations of motion on projections on the axes of the coordinate system and on the basis of the relationship between the direction cosines of unit vectors of the curve describing the shape of the filament. Closure of the problem is specified by the initial conditions defining the shape of the filament at the commencement of its motion and the rate of its motion, which is constant for all points on the filament, as well as by the boundary conditions with allowance for the symmetry of the problem. The

solution of the problem involves the isolation of two components of vertical displacement of filament points, one of which describes the motions of the filament as those of a rigid body. The derived quasilinear system of integrodifferential equations is solved by the method of successive approximations. The solution of the corresponding linear boundary-value problem is achieved by the Bubnov method in vector-matrix form. On the basis of the exact orthonormalized system of functions of the boundary-value problem, the formalism of the method is represented by vector-functions and results in a system of ordinary differential equations. The initial conditions of the corresponding Cauchy problem are analogously derived through minimization of the original initial conditions.
[25-1386]

USSR

UDC 539.3

BENDING OF A CIRCULAR ORTHOTROPIC PLATE SUPPORTED BY A NONLINEAR ELASTIC BASE, UNDER THE ACTION OF UNEQUAL LATERAL AND LONGITUDINAL LOADS

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV. [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 424, 1977 pp 73-77

ISHKOVA, A. G. and TIMUSHEV, S. F.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V235 by G. Ya. Popov]

[Text] The axisymmetrical problem of the bending of an orthotropic circular plate supported on a nonlinear elastic Winkler base, under the action of an arbitrary lateral load and a uniform peripherally distributed longitudinal load, is considered. The longitudinal load is either tensile or compressive (the problem of stability is not investigated) in the plane of the plate. The nonlinearity of the base is determined by the formula $p = \gamma w - \beta w^2$, where p is the contact stress, w is the flexure; γ and β are constants. A description is given of the solution, based on utilizing the small parameter method with parameter $\mu = \beta D\rho^{-1}$ ($D\rho$ is the rigidity of the plate in the radial direction) in combination with the power-series expansion of both the unknown and the specified functions, Numerical results are not given.
[25-1386]

USSR UDC 539.3:534.1

DYNAMICS OF A SHELL OF REVOLUTION WITH AN ATTACHED MASS UNDER AN AXIAL IMPACT LOAD

Tomsk TEORIYA UPRUGOSTI I PLASTICHNOSTI [Theory of Elasticity and Plasticity] in Russian 1978 pp 18-22

BABIN, A. I. and LYUKSHIN, B. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V307 by the authors]

[Text] The dynamics of an elastic shell of revolution with rectilinear generatrices is considered for shells rigidly joined at one end to an element of a given mass and subjected to a high-intensity axial impact load in the form of body forces. The process of transformation of the momentum of the impact load, specified for the unloaded end of the shell, is investigated in the presence of the passage of the perturbation wave along the structure depending on the geometrical parameters of the shell and the mass ratio between the attached element and the shell. References 7. [25-1386]

USSR UDC 539.3:534.1

EFFECT THAT THE SHAPE OF AN AXIAL IMPACT LOADING PULSE HAS ON THE DEFORMATION OF A CYLINDRICAL SANDWICH SHELL

Tomsk TEORIYA UPRUGOSTI I PLASTICHNOSTI [Theory of Elasticity and Plasticity] in Russian 1978 pp 35-37

LYUKSHIN, B. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V308 by the author]

[Text] On the basis of a numerical analysis the pattern of the axisymmetric deformation of a cylindrical shell with and without a filler, when subjected to an aperiodic impact load in the form of high-intensity body forces, is investigated as a function of the shape of the impact pulse. The investigation of shell dynamics is based on equations of a second-approximation model; in the case of the shell with a filler, a quasistatic computational scheme that does not allow for the wave pattern of deformation of the shell, is employed. The numerical findings are presented in the form of a plot showing the curves for shells with and without a filler in the presence of

sliding side-surface contact and unilateral bonding between the shell and the filler.
[25-1386]

USSR

UDC 539.3

DEVICES AND METHODS FOR DETERMINING LOCAL PRESSURES EXERTED BY RUBBER SHELLS ON THE OBJECTS THEY ENCLOSE

TRUDY NII REZINOVOY PROMYSHLENNOSTI [Transactions of the Scientific Research Institute of the Rubber Industry] in Russian No 2/9, 1977 pp 118-123

ZAKHAR'YEV, G. A., MIKHEYEVA, YE. V., MIL'VIDSKIY, M. K. and RODINA, N. I.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V157]

[Text] The design and operating principles of a moulage device with pneumatic sensors built into a strip obturator, used as the basis for the instrument method of estimating local pressures on protective helmets, caps, and other rubber shells of analogous design are described.
[25-1386]

USSR

UDC 539.3

AXISYMMETRIC DEFORMATIONS OF VARIABLE-THICKNESS SHELLS OF REVOLUTION MADE FROM NONLINEARLY ELASTIC MATERIALS

UCHENYYE ZAPISKI. AZERBAYDZHANSKIY INZHENERNO-STROITEL'NYY INSTITUT [Scientific Annals. Azerbaijan Civil Engineering Institute] in Russian Series 10, No 2, 1977 pp 159-167

SADYKHOV, I. R. and IBRAGIMOVA, G. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V154 by A. V. Borodin]

[Text] The problem of the static loading exerted by internal pressure on variable-thickness shells of revolution made from a nonlinearly elastic material is considered in the axisymmetric formulation. The basic formulas of A. A. Il'yushin's deformation theory of elasticity are employed. The input equations used are differential equilibrium equations of the shallow

shell theory. The principal unknown problems are taken to be the transverse force and the angle of turn of the tangent to the meridian, and they are determined by deriving a system of two nonlinear differential resolvents. The linearization of the derived system of equations is based on utilizing the perturbation method with introduction of two small perturbing parameters, one considering the effect of physical nonlinearity and the other, the variation in the geometrical characteristics of the shell. The resolvent functions are represented by expansions with respect to powers of small parameters. As a result of such expansion, the problem reduces to successive approximation of fixed-thickness shells of revolution made from linearly elastic materials. The accuracy of the solution depends on the number of the retained terms in the expansion with respect to powers of small parameters. [25-1386]

USSR UDC 539.3:534.1

DESIGN OF CYLINDRICAL SHELLS MADE OF MULTILAYERED COMPOSITE MATERIALS GIVEN CONSTRAINTS ON STRENGTH AND STABILITY

Ramenskoye UCHENYYE ZAPISKI TSENTRAL'NOGO AERO-GIDRODINAMICHESKOGO INSTITUTA [Scientific Annals of Central Aerohydrodynamics Institute] in Russian Vol 9, No 1, 1978 pp 78-83

KRASHAKOV, YU. F., RUBINA, A. L. and SUKHOBOKOVA, G. P.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V412 by the authors]

[Text] A procedure for designing thin walled composite-material shell structures of minimum weight for the case of axial compression upon satisfaction of strength and stability requirements is presented. A combined solution is found: the optimal arrangement is determined for orientation of layers in a multilayered composite material of a shell of minimum thickness, such that the resultant stresses do not exceed the critical and limiting stresses.

A sample design of a circular cylindrical shell of carbon-reinforced plastic is presented.
[25-1386]

USSR UDC 534

ENERGY EXCHANGE BETWEEN TWO COUPLED LINEAR OSCILLATORY SYSTEMS

Irkutsk UPRAVLYAYEMYYE MEKHANICHESKIYE SISTEMY [Controllable Mechanical Systems] in Russian 1977 pp 76-82

NERUBENKO, G. P.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A145 by the author]

[Text] The problem of determining the amount of power exchanged between two weakly connected linear oscillators is considered. For the case of arbitrary forces acting on the oscillators, a formula is derived for the part of the power transmitted via elastic coupling from one oscillatory link to the other. The derivation is based on analogy between thermodynamic and oscillatory models. A convenient procedure is proposed for using numerical methods to determine the power exchanged between oscillators for specific systems.
[25-1386]

USSR UDC 534

STRUCTURAL ANALYSIS OF COMPLEX MECHANICAL OSCILLATORY SYSTEMS: ONE-DIMENSIONAL ACTIVE SYSTEMS WITH ELECTROHYDRAULIC ANTI-VIBRATION DEVICES

Irkutsk UPRAVLYAYEMYYE MEKHANICHESKIYE SISTEMY [Controllable Mechanical Systems] in Russian 1977 pp 178-189

ZASYADKO, A. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A146 by the author]

[Text] The findings of a theoretical investigation of one-dimensional mechanical oscillatory systems with active electrohydraulic devices are presented. A procedure for the structural analysis of these systems is worked out, the characteristics of active electrohydraulic antivibration systems are determined, and the system designs are evaluated.
[25-1386]

USSR UDC 531.001

USING A ZHUKOVSKIY PENDULUM TO DETERMINE THE FRICTION COEFFICIENTS OF FLEXIBLE BODIES

VESTNIK KIEVSKOGO POLITEKHNICHESKOGO INSTITUTA. MASHINOSTROYENIYE [Herald of the Kiev Polytechnic Institute. Machine Building] in Russian No 15, 1978 pp 96-99

TRIVAYLO, M. S., GERASIMOV, G. V. and KOVALEV, M. S.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A38 by the authors]

[Text] The conditions of the friction of flexible bodies on a rotating axis that at the same time represents the swing axis of a strip pendulum are examined. It is shown that when the angular velocity of rotation of the axis exceeds the angular velocity of the pendulum, the oscillations of the pendulum become free and the swing axis shifts in the direction of the rotation of the axis of the pendulum's suspension through an angle that is directly proportional to the angle of friction. A formula for determining the coefficient of friction of flexible bodies is presented. It is pointed out that the use of a Zhukovskiy pendulum independently or in combination with known research techniques serves to broaden the possibilities for experimental research into the processes of the friction of flexible bodies and to obtain more reliable results.
[25-1386]

USSR UDC 539.3:534.1

DYNAMIC ANALYSIS OF CIRCULAR PLATES OF VARIABLE THICKNESS ON DISREGARDING THE KIRCHHOFF HYPOTHESIS

Kuybyshev VOPROSY PROYEKTIROVANIYA I DOVODKI AVIATSIONNYKH GAZOTURBINNYKH DVIGATELEY [Problems of the Design and Adjustments of Aircraft Gas-Turbine Engines] in Russian 1977 pp 122-130

FRIDMAN,L.I.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8V326 by I. N. Danilova]

[Text] An algorithm for the solution of the dynamic problem of normal modes and frequencies is presented for a plate of variable thickness, and the solution of the problem of forced oscillations is given. The Kirchhoff hypothesis is not used. In the solution of the problems the plate of variable thickness is replaced with a staggered plate consisting of annular plates of a fixed thickness.
[25-1386]

Navigation and Guidance Systems

USSR UDC 533.652/661.013

LONGITUDINAL STABILITY AND CONTROLLABILITY OF AIRCRAFT DURING ICING OF STABILIZER TIP

Kiev AERODINAMIKA in Russian No 3, 1977 pp 53-62

LAZNYUK, P. S., KABANYACHIY, V. V. and SOTNIKOV, D. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1287]

[Text] Transient processes of the longitudinal motion of AN-24 aircraft during their approach to the landing strip in a situation in which ice forms on the stabilizer tip are analyzed. The landing configuration of the aircraft is examined. The calculations apply to the operating range of centering maneuvers and various laws of elevator control. Calculations of transient processes in short-period motion and with allowance for variation in flight speed are compared.
[25-1386]

USSR UDC 62-50

APPLICATION OF A SUCCESSIVE APPROXIMATION METHOD TO THE DETERMINATION OF CERTAIN DYNAMIC CHARACTERISTICS OF A TETHER AS A CONTROLLED OBJECT

Moscow O PRIMENENII METODA POSLEDOVATEL'NYKH PRIBLIZHENIY K OPREDELENIYU NEKOTORYKH DINAMICHESKIKH KHARAKTERISTIK PRIVYAZI KAK OB"YEKTA UPRAVLENIYA in Russian manuscript deposited at VINITI 25 May 78 No 1724-78 Dep. 1978 10 pp

TIKHONOV, V. S., Moscow Aviation Institute

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A107 DEP by the author]

[Text] A method for determining the associated characteristics of a tether in a flow is presented. In the case considered the associated characteristics of the tether--mass and damping, are construed as the additional forces acting on the point of attachment of the tether and dependent on the acceleration and velocity of the object. A method of successive approximations is used to solve the system of partial differential equations describing the movement of the tether; this method reduces the problem to a system of ordinary differential equations. A sample analysis of a tether

system is presented for a tether whose lower end is fixed in place while the upper end executes a specified motion. Consideration of the associated characteristics is proposed as a way of refining the mathematical model of the tether as a controlled object. References 6.
[25-1386]

USSR UDC 62-50

OPTIMIZATION OF A PITCH GYRO CORRECTION SYSTEM

SBORNIK NAUCHNYKH [TRUDOV]. PERMSKIY UNIVERSITET [Anthology of Scientific Works. Perm' University] in Russian No 199, 1977 pp 64-67

KOSTROV, A. V. and SHTRASBERG, L. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A95 by the authors]

[Text] Features of the application of a reduced Kalman filter to the optimization of a pitch gyro correction system are examined. The resulting system is feasible. It displays a sufficiently high accuracy and short transient-process time.
[25-1386]

USSR UDC 531.001

CONTROL OF THE MOTION OF THE CENTER OF MASS OF A ROTATING SPHERE OF VARIABLE MASS MOVING ALONG AN ELONGATED TRAJECTORY

SBORNIK PO VOPROSAM MEKHANIKI I PRIKLADNOY MATEMATIKI [Anthology on Problems of Mechanics and Applied Mathematics] in Russian No 9, 1977 pp 5-14

KONDRASHEV, S. T.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A34 by the author]

[Text] An exact program for a cycloid in space that, depending on the parameters, may move at various angles to the horizon, is considered. The relative velocities are assumed to be variable. To find the control effects, the active sector is partitioned into segments which serves to

reduce the determination of the pattern of variation in mass to the solution of a differential equation with constant coefficients. References 6. [25-1386]

USSR UDC 533.652/661.013

SUFFICIENT CONDITIONS OF STABILITY OF THE PROGRAMMED MOTION OF FLIGHT VEHICLES

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 424, 1977 pp 26-31

SGILEVSKIY, V. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1280 by G. S. Aronin]

[Text] Conditions of the stability of motion of a flight vehicle are considered with allowance for the variation in its mass in the general case for ascending and descending trajectories as based on the construction of Lyapunov's functions in positive definite quadratic form with regard to perturbations of speed, inclination angle of the trajectory, and the flight altitude. The obtained sufficient conditions of negativeness of the derivative of Lyapunov's function satisfy a broad class of trajectories of programmed motion of the vehicle. These conditions depend on the combination of perturbations of the speed and trajectory inclination angle and serve to determine the range of permissible variable coefficients of Lyapunov's function characterizing the conditions of programmed motion of the vehicle for a given flight trajectory. In the design calculations allowance should be made for inequality-type constraints imposed by conditions of stability on the selection of parameters of engines and vehicle and linking the altitude-speed characteristics of engines and the aerodynamic quality of the vehicle with respect to specific flight conditions. [25-1386]

USSR UDC 533.652/661.013

STABILITY OF THE LONGITUDINAL MOTION OF AN AUTOPILOT FLIGHT VEHICLE IN THE PRESENCE OF FLUCTUATING VARIATION IN ITS "CENTERING"

TEMATICHESKIY SBORNIK NAUCHNYK TRUDOV. [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 424, 1977 pp 32-37

YURKEVICH, L. R. and KURAYEV, A. YU.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1281 by G. S. Aronin]

[Text] Longitudinal short-period motion of a flight vehicle in the horizontal flight mode without thrust in the presence of non-damping longitudinal harmonic oscillations of its center of gravity relative to its mean position is considered. It is assumed that the vehicle is equipped with an ideal autopilot with sensors of normal overload and angular velocity of pitching. The differential equation of motion is reduced to a Mathieu equation: the stability of solutions of this equation is analyzed for various values of its parameters. Examination of certain instances indicates that an asymptotically stable (with respect to angular velocity in pitch) motion of the flight vehicle requires a circular oscillation frequency of its center of gravity that should be below a certain limit which depends on the flight mode and the design parameters of the vehicle and the autopilot. References 5.
[25-1386]

USSR UDC 533.652/661.013

ANALYSIS OF THE REGION OF STABLE AIRCRAFT MOTION WITH RESPECT TO ANGLE OF ATTACK DURING UNSTEADY-SPEED FLIGHT MODES

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV. [Thematic Collection of Scientific Works]in Russian, Moscow Aviation Institute No 427, 1977 pp 19-23

VYSKREBENTSEV, L. I.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1283 by G. S. Aronin]

[Text] The problem of the analysis of stability regions of short-period motion of aircraft with respect to the angle of attack during acceleration and deceleration within a finite time interval (10-15 sec) is considered from the standpoint of the concepts of technical stability and instability

of motion. The motion considered is described by a linearized second-order differential equation with variable coefficients. A region of guaranteed damping of transient processes which, according to calculational findings, is narrower than the overall damping region, is constructed with the aid of unified coordinates derived from the coefficients of this equation. It is not possible to derive analytic formulas for estimating the effect of the variation in the coefficients of the differential equation on the dynamic characteristics of the transient process (e.g. on the extent of over-regulation), but numerous calculations for various aircraft during various flight modes reveal an overall pattern governing this effect.
[25-1386]

USSR UDC 533.652/661.013

PROBLEM OF CONTROLLING LATERAL MOTION OF AIRCRAFT DURING RUNWAY TAXIING

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV MOSKOVSKOGO AVIATSIONNOGO INSTITUTA [Thematic Collection of Scientific Works] in Russian Moscow Aviation Institute No 427, 1977 pp 34-37

ZHARKOV, YE. P.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1282 by G. S. Aronin]

[Text] The problem of automating lateral motion of aircraft on the landing runway from the instant of landing until the instant when the aerodynamic steering gear causes to be effective is considered. The reference trajectory is taken as the taxiing trajectory derived with allowance for known dependences on time, taxiing speed, balanced position of the elevator, friction coefficient, extent of the compression of landing-strut shock absorbers, the coefficients of aerodynamic forces and moments at specified initial conditions (landing speed, inclination angles of trajectory and pitch). Equations of perturbed motion of the aircraft are derived from the premise of the absence of banking at the moment of landing, of linearity of the dependence between deflections of the rudder and the nose wheel, and of the action of only the constant component of side wind on the aircraft. Given the possibility of continuous measurement of phase coordinates (lateral g-force, angular velocity and yaw, lateral displacement of the center of mass of the aircraft relative to the runway axis and the angle between the vectors of airspeed and ground speed), a continuous optimal pattern of rudder control with feedback is achieved. The results of digital simulation presented in the article show that the synthesized control law (at an initial lateral displacement of 20 m to the windward side and in the presence of a side wind of 20 m/sec) centers the aircraft

on the runway with a moderate lateral g-force (up to 0.1) and moderate deviations and rates of deflection of the rudder.
[25-1386]

USSR UDC 533.652/661.013

EFFECT OF ELASTICITY OF DESIGN ON THE CHARACTERISTICS OF THE LONGITUDINAL SHORT-PERIOD MOTION OF HEAVY AIRCRAFT

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 427, 1977 pp 38-44

ZHIVOV, YU. G. and SVETLICHNYY, P. P.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1289 by G. S. Aronin]

[Text] The article deals with determining the coefficients of the equations of short-period longitudinal motion of an aircraft considered as a rigid body with corrections for elasticity of structure. Considering that the natural frequencies of the first three harmonics of elastic vibrations are an order of magnitude higher than the frequency of short-period motion, only the quasistatic effect needs to be taken into account, and the inertial and velocity forces due to the elasticity of the structure of a heavy aircraft having high-aspect sweptback wings cause the longitudinal static stability margin and the effectiveness of the ailerons to decrease by a factor of 2 and more, while at the same time reducing by 20-40% the effectiveness of the elevator, of longitudinal damping, and of the derivative of lift with respect to the angle of attack. The consideration of quasistatic deformations alone accounts for 80-90% of the total effect of elasticity in the region of the frequencies of short-period motion, with the first elastic harmonic of the wings making the principal contribution.
[25-1386]

USSR UDC 629.761.78.015:533.6

EQUATIONS OF THE MOTION OF A FLIGHT VEHICLE AS A MATERIAL POINT WITHIN AN INERTIAL REFERENCE FRAME IN PROJECTIONS ON VELOCITY AXES

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV. [Thematic Collection of Scientific Works] in Russian, Moscow Aviation Institute No 427, 1977 pp 55-60

LEONOV, V. A., YELISEYEVA, N. S. and SABLINA, YE. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1326 by G. S. Aronin]

[Text] The matrices of coordinate transformations between localized and semi-localized, semi-localized and velocity, velocity and localized, and between velocity and earth-fixed (normal) frames of reference are presented. The components of the vectors of angular velocity, aerodynamic forces, gravity, and engine thrust acting on the velocity axes are determined. Corresponding equations of motion of a flight vehicle as a material point of variable mass relative to a nonrotating flat earth in projections on velocity axes are composed, and kinematic equations for calculating flight altitude and the longitudinal and lateral flight ranges are presented. [25-1386]

USSR UDC 533.652/661.013

QUALITATIVE ANALYSIS OF THE PROBLEM OF FLIGHT DYNAMICS

TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV [Thematic Collection of Scientific Works] in Russian Moscow Aviation Institute No 427, 1977 pp 65-70

PAVLOV, K. A.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8B1291 by G. S. Aronin]

[Text] Relative motion of two aircraft in the horizontal plane, as determined by variations in their speeds, relative location, and course angles, is considered from the standpoint of the theory of games. Differential equations of motion in these variables are presented, the regions of dynamic advantage of the first and the second aircraft, as separated by a barrier, are determined, and the surface of the zero speed of mutual approach, dividing the phase space into two regions--near and far--is considered. Also considered are the barriers delineating the region of

guaranteed escape by the slower aircraft, and the region of guaranteed safe escape by the aircraft with the greater speed. The possibilities for escape can be expediently utilized in the regions of dynamic superiority of the other aircraft.
[25-1386]

USSR UDC 531

MOTION RELATIVE TO THE CENTER OF MASS OF A RIGID BODY CARRYING INDUCTION GYROMOTORS

Dolgoprudnyy TRUDY 22-Y NAUCHNOY KONFERENTSII MFTI 1976 G. SERIYA AEROFIZIKA I PRIKLADNAYA MATEMATIKA [Proceedings of the 22nd Scientific Conference of Moscow Physico-Technical Institute, 1976. Series on Aerophysics and Applied Mathematics] in Russian 1977 pp 97-104

YEGARMIN, N. YE.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A62 by V. V. Krementulo]

[Text] Rotational motion about the center of mass of a rigid body carrying flywheels actuated by electric induction motors is investigated by the averaging method. It is assumed that such a mechanical system is not subject to the effect of external torques. Motion of the Euler-Poinsot type is investigated in two cases (epicycloidal and pericycloidal). The solutions obtained are expressed through elliptical functions. The findings also apply to precession theory with respect to a rigid body carrying gyroframes. The formulas and estimates derived in this work can be utilized in assessing the damping effect of gyroscopic devices on the motion of artificial earth satellites about centers of mass. References 5.
[25-1386]

USSR UDC 62-50

OPTIMAL CONTROL OF THE TURNING OF A FREE BODY WITH ELASTIC ELEMENTS

Irkutsk UPRAVLYAYEMYYE MEKHANICHESKIYE SISTEMY [Controllable Mechanical Systems] in Russian 1977 pp 4-14

ZAKRZHEVSKIY, A. YE.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A94 by the author]

[Text] It is shown that control of the programmed turning of a free body with attached elastic elements by means of control laws applying to absolutely rigid bodies may result in impermissible orientation errors by the end of a maneuver owing to the excitation of oscillations of the elastic elements. Accordingly, an algorithm for constructing an optimal control law serving to turn the free body with elastic elements through a specified angle relative to one of the major axis of the undeformed system is proposed. With the aid of this algorithm the orientation error by the end of a turning maneuver will not exceed the specified limit.
[25-1386]

USSR UDC 62-50

PROBLEM OF THE OPTIMAL DECELERATION OF A FREE BODY

Irkutsk UPRAVLYAYEMYYE MEKHANICHESKIYE SISTEMY [Controllable Mechanical Systems] in Russian 1977 pp 91-100

STEPANOV, A. P., SHKLYAR, V. N. and MALYSHENKO, A. M.

[From REFERATIVNYY ZHURNAL, MEKHANIKA No 8, 1978 Abstract No 8A93 by the authors]

[Text] The problem of the energy-optimal deceleration of a freely spinning dynamically axisymmetric body with constraints on deceleration time and final position of the body's fixed axis is considered. Spin control is accomplished along a fixed axis whose position coincides with the vector of the body's instantaneous angular velocity at the instant when the orientable axis reaches the boundary of the specified region of its final position. An algorithm for the optimally rapid damping of the body's initial angular velocity is presented. References 5.
[25-1386]

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